Geographical Regularities in the Worldwide Diffusion of Natural-Endemic Diseases

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GEOGRAPHICAL REGULARITIES IN THE WORLDWIDE DIFFUSION OF NATURAL-ENDEMIC DISEASES

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ABSTRACT: At present, medical geography pays considerable attention to the study of regularities in the influence of natural and social conditions on the health of the population. It is possible to argue that even potentially effective prophylactic arrangements will not be successful if they do not take into account data on spatial differences in the spread of diseases. The aim of this investigation is to examine diversity in the geography of natural-endemic diseases across the world on the basis of a special database. The analysis focuses on the spread of 34 diseases, the parasitic systems of which are members of natural ecosystems. The paper proposes some approaches to the study of spatial differentiation which can be used for the analysis of contrasting health levels for different diseases and related environmental characteristics.
KEY WORDS: natural-endemic diseases, diversity, spatial analysis of epidemiological data.

RESUM: En aquest treball sobre la geografia de la salut es posa especial atenció sobre les regularitats i influències de la salut de la població segons la seva condició social i la seva naturalesa. És possible argumentar que àdhuc amb potencials accions profilàctiques les solucions poden no tenir èxit si no es tenen en compte les diferències espacials de cada malaltia. L'objectiu d'aquestes investigacions és examinar la diversitat geogràfica de les malalties naturals endèmiques arreu del món en el si dels seus ecosistemes naturals. L'anàlisi es focalitza en l'estudi de 34 malalties, en les quals actuen paràsits que conviuen de forma natural en els ecosistemes. El treball proposa algunes aproximacions a l'estudi d'aquestes diferències espacials en les quals s'analitzen i contrasten els distints nivells de salut per a cada malaltia relacionada amb el seu ambient característic.
PARAULES CLAU: malalties naturals endèmiques, diversitat, anàlisi espacial de les dades epidemiològiques.

1. Introduction

At present, medical geography pays considerable attention to the study of regularities of influence of natural and social conditions of concrete territories on the health of the population. It is possible to insist that even potentially effective prophylactic arrangements will not be successful if they do not take into account data on spatial differences in spreading of diseases (Malkhazova, 2001).

Of considerable risk to population health are various natural-endemic diseases the pathogens or carriers of which are a part of natural ecosystems. Parasitical systems of such diseases can be considered to be a biotic component, which is organic for natural ecosystems.

The aim of this investigation is to determine diversity in the geography of natural-endemic diseases all over the world on the basis of the special database. The spread of 34 diseases, the parasitic systems of which are members of natural ecosystems was analysed.

These naturally-caused infectious and parasitical diseases include mainly transmissible diseases[1], anthroponoses[2], zoonoses[3], and some helminthoses[4] of which pathogens have a development stage in the outer environment. The pathogens of the former two disease groups are closely connected to particular kinds of animals, which can be their intermediate or final hosts, keepers and vectors. The presence of these animals (vertebrates, arthropods, molluscs, etc.) in ecosystems provides a pathogen with circulation and consequently creates the possibility of transmitting the diseases to humans.

Those areas seem to be extreme in relation to the biotical component, where biotical factors lay down a high risk of infecting man and where normal human life depends on carrying out special prophylactic and other measures to avoid infection.

For instance, it is well known that in some regions in temperate and subtropical longitudes man has long avoided settling in marshy areas because of the significant risk of infection with malaria. In the African savannah, the hazard of humans and cattle contracting a trypanosomiasis disease still dictate that places of settlement and cattle breeding do not overlap with habitats of tsetse flies and transmitters of the disease. It is worth emphasizing that vast areas of African savannah remain unsettled and underdeveloped in spite of the relative climatic comfort and accessibility of productive pastures. The local population abandons many fertile river-valleys due to the risk of infection with the natural-endemic onchocerciasis disease that is widespread in these valleys. Because of its most serious complication –affection of eyes and subsequent blindness– these valleys were given the name of ‘valleys of the blind’. In some regions of West Africa the percentage of blind people may reach 35 per cent of the population.

In areas where they are widely distributed, natural-endemic diseases such as malaria, trypanosomiasis and onchocercosis prevent implementation of development projects for water resources, agriculture, forestry, increase the cost of the projects, and essentially turn out to be the genuine social disaster (Loffler and Malkhazova, 1988; Malkhazova and Neronov, 1988). That is why medical geographical assessment of a territory based on a set of natural-endemic diseases is an urgent task of practical importance and topicality.

2. Methodology and material

The basis for compiling the maps of medical geographical assessment of the environment was provided by the concept of disease preconditions that was formulated in Russia in the 1960s (Ignatiev, 1964) and subsequently developed (Vershinski, 1964;

1 Transmissible diseases - pathogens are communicated by arthropod carriers (mosquitoes, ticks, midges, etc.).
2 Anthroponoses - common for man and animals diseases, of which the main carrier is man.
3 Zoonoses - common for man and animals diseases, of which the main carrier is an animal.
4 Helminthoses - diseases caused by parasitic worms.

Malkhazova and Neronov 1983; Neronov and Malkhazova, 1985; Neronov, Malkhazova and Tikunov, 1991).

According to this concept, some attributes of geo-systems influence (or may influence) human health and condition the possible emergence of natural-endemic diseases within the area. Every geo-system has its own inherited range of natural preconditions for human diseases, i.e. every landscape has several typical parasitical systems produced in specific ecological conditions providing their functioning. A set of typical natural-endemic diseases for an area and their distribution features can be used as indicators of *nosogeneity*, or the epidemical potential of natural ecosystems.

By considering parasitical systems as a biotical component organically related to natural-territorial complexes, one can provide an assessment of the environmental extremity in relation to the natural-endemic diseases proceeding from the nosogeneity of an area, this being expressed by different indicators.

Since the geography of natural-endemic diseases and the structure of their habitats depend largely on environmental factors, different physical-geographical maps are required for the medical-geographical assessment of terrain in relation to preconditions for diseases.

Conducting the medical-geographical assessment of an area on a small scale (less than 1:2500000), a division of the landscape sphere is usually a geographical (natural) belt or natural zone (sub-zone). Therefore, maps of geographical belts and zonal types of the world's landscapes provided a cartographical base for this study. The operational-territorial unit for assessing the natural preconditions for the existence of diseases on a worldwide scale was a geographical belt, whereas the unit for a more detailed analysis of the medical geographical situation in Africa was a zonal type of landscape. Modified versions of published maps were used as the basis for the study (Present-day…, 1993; Resources…, 1998).

Thirty-four natural-endemic diseases were selected to carry out the medical geographical assessment of the global natural environment. A characteristic feature of these selected nosological units is that the potential existence of pathogens, carriers and their intermediate hosts in an area fully depends on natural conditions, and the realisation of these natural preconditions is related to social and socio-economic circumstances. Besides, these diseases are predominant in the population pathology and present not only a medical but also a socio-economic problem.

These typical diseases are:

1) alveococcosis, 2) ancylostomiasis, 3) hydrophobia (rabies), 4) brugiosis, 5) brucellosis, 6) disease caused by the virus of eastern equian encephalomyelitis (EEE), 7) disease caused by the virus of western equian encephalomyelitis (WEE), 8) disease caused by the Colorado fever virus, 9) disease caused by the San Luis' virus (SLV), 10) Chagas' disease, 11) bancroftian filariasis, 12) epidemic hemorrhagic fever, 13) dracunculiasis (guinea worm), 14) yellow fever, 15) iersineosis, 16) tick-borne rickettsiosis of North Asia, 17) tick-borne encephalitis, 18) clonorchiasis, 19) visceral leishmaniasis, 20) cutaneous leishmaniasis, 21) leptospirosis hemorrhagica, 22) leptospirosis icterohemorrhagica, 23) Pomon's leptospirosis, 24) loaosis, 25) malaria, 26) necatoriasis, 27) onchocerciasis, 28) paragonimosis, 29) sleeping-sickness, 30) strongyloidosis, 31) tularaemia, 32) intestinal schistosomiasis, 33) urinary schistosomiasis, 34) eastern schistosomiasis

Information about the geographical distribution of natural-endemic diseases and the intensity of their development was garnered from literature. The methodology used was developed by E. L. Raikh and L. V. Maximova (1988), but it was employed with several modifications (Malkhazova and Karimova, 1990; Malkhazova, 2001). The essence of the methodology is as follows. Habitats of the selected natural-endemic diseases were studied within the geographical belts. A list of occurring diseases was created for each belt. It should be noted that we studied the belts along the continents and in some cases also along regions, as the lists of diseases as well as their habitats vary considerably in different parts of the world.

To find the nosogeneity of an area it was necessary to study both the *intensity of the natural preconditions* for a disease (the intensity of dissemination and transfer of the pathogen) and its *loimopotential* (risk of infection) by the number of nosological units (nosoforms). The rate of intensity of the natural preconditions for each disease in a contour was estimated according to a three-level scale: high – 3 (the disease is present everywhere), middle – 2 (the disease is found in certain areas), and low – 1 (the disease is found in certain foci). Then, the values reflecting the rate of intensity of the preconditions in all nosological units were summed up for every geographical belt. In addition to the sum of the intensity of the preconditions for a group of diseases, the total value (sum index) also took into account a diversity (abundance) of typical nosoforms and the number of diseases with a high intensity of preconditions.

The following entry-form of the sum index is used: **A/B/C**, where **A** is the sum intensity of the preconditions of a range of diseases, **B** is the number of nosoforms, and **C** is the number of nosoforms with a high intensity of the preconditions. The results of the sum indexes calculations for the natural preconditions of the diseases typical for particular geographical belts of the world are shown in Table 1.

By ascertaining the sum intensity of the preconditions for a range of diseases and their diversity for all types of territories, it is possible to estimate the potential hazard of the natural belts in the world in relation to a complex of natural-endemic diseases.

G.A. Sterges' formula was used for building the scales, and thus the interval was calculated:

$$Xmax - Xmin / I + 3.32 \lg n,$$

where ***Xmax*** and ***Xmin*** are maximum and minimum values of the sum intensity of the preconditions (in grades); ***n*** is the number of medical-geographical types of territories.

As the analysis has shown, the values of the sum intensity of the natural preconditions vary from 2 to 30. Accordingly, three gradations were appointed: low (under 10), medium (10-20) and high (more that 20). The diversity by number of nosoforms was determined as: low (2-6), medium (7-10) and high (11-14). The cartographic interpretation of the results is presented on the map of «Medical geographical assessment of world geographical belts (according to a complex of natural-endemic diseases)» (figure 1).

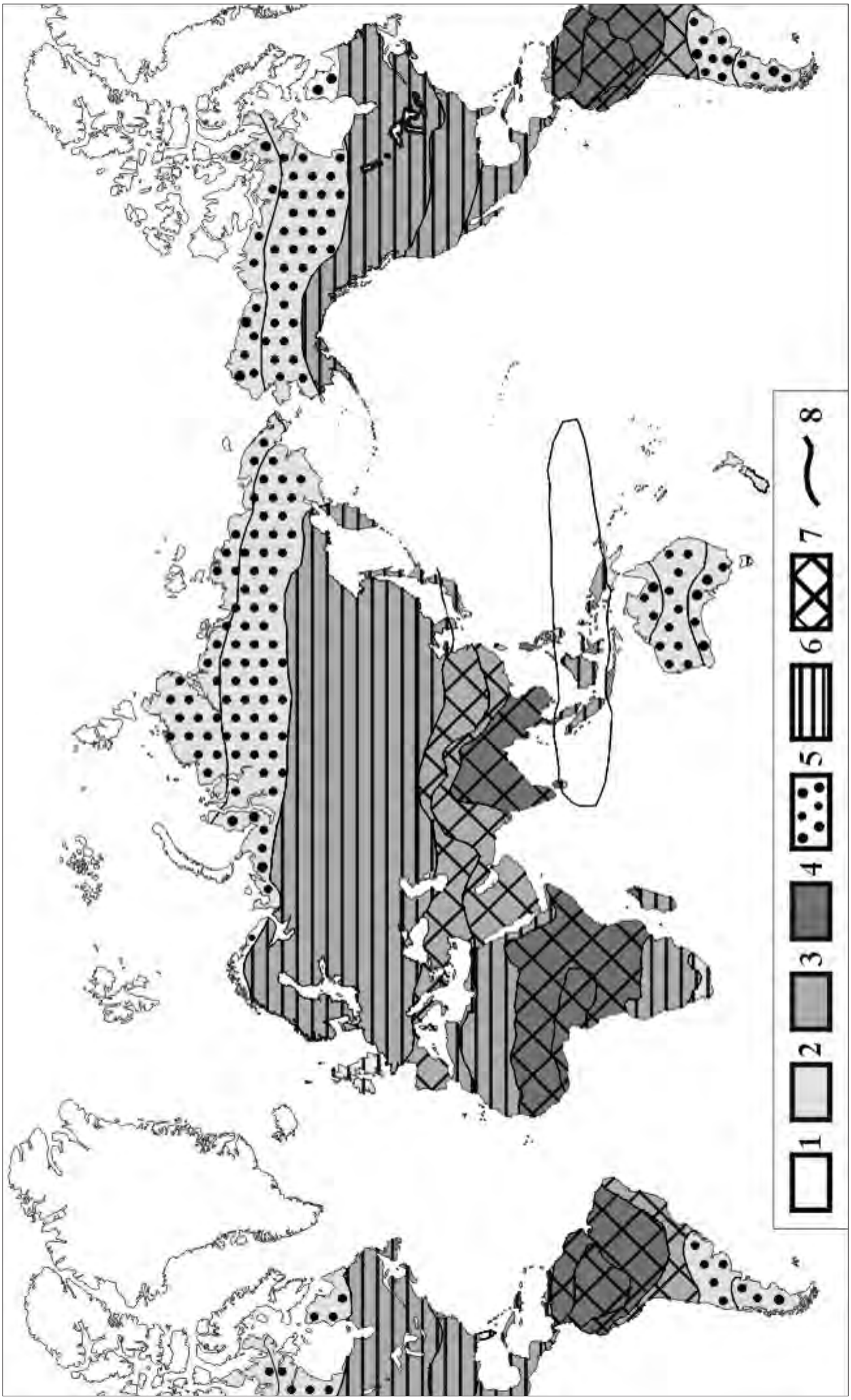

Fig. 1. Medical geographical assessment of world geographical belts (according to a complex of natural-endemic diseases).

Intensity of natural preconditions: 1 - absent, 2 - low, 3 - medium, 4 - high; diversity by the number of nosoforms: 5 - low, 6 - medium, 7 - high; 8 - borders of geographical belts

Table 1. Natural-endemic diseases typical for geographical belts of the world's land.

Continent	Name of disease	Intensity of natural preconditions	Sum index
		Tropical belt	
North America	Ancylostomiasis	1	15/9/0
	Chagas' disease	2	
	Yellow fever	1	
	Visceral leishmaniasis	1	
	Cutaneous leishmaniasis	2	
	Malaria	2	
	Necatoriasis	3	
	Onchocerciasis	1	
	Strongyloidosis	2	
South America	Ancylostomiasis	2	19/13/0
	Chagas' disease	2	
	Bancroftian filariasis	1	
	Yellow fever	1	
	WEE	1	
	Visceral leishmaniasis	1	
	Cutaneous leishmaniasis	2	
	Malaria	2	
	Necatoriasis	2	
	Paragonimosis	1	
	Strongyloidosis	2	
	Intestinal schistosomiasis	1	
	SLV	1	
North Africa	Ancylostomiasis	1	10/9/0
	Bancroftian filariasis	1	
	Dracunculosis	1	
	Visceral leishmaniasis	1	
	Cutaneous leishmaniasis	1	
	Malaria	1	
	Strongyloidosis	2	
	Intestinal schistosomiasis	1	
	Urinary schistosomiasis	1	
South Africa	Ancylostomiasis	1	10/8/0
	Bancroftian filariasis	1	
	Malaria	2	
	Necatoriasis	1	
	Sleeping-sickness	1	
	Strongyloidosis	2	
	Intestinal schistosomiasis	1	
	Urinary schistosomiasis	1	
Asia	Ancylostomiasis	1	14/11/0
	Bancroftian filariasis	1	
	Dracunculiasis	1	
	Visceral leishmaniasis	1	
	Cutaneous leishmaniasis	2	
	Malaria	2	
	Necatoriasis	1	
	Onchocerciasis	1	
	Strongyloidosis	1	
	Intestinal schistosomiasis	1	
	Urinary schistosomiasis	1	

3. Results and discussion

3.1. The assessment of intensity of natural preconditions in the world

The analysis of the resulting map shows that territories with a low intensity of natural preconditions are very limited. The lowest intensity of natural preconditions and amount of disease can be found in the polar belt of North America and Eurasia as well as in Australia and New Zealand, the temperate and subtropical belts of South America and the southern subtropics of Africa. Such a medical geographical situation can be explained, on the one hand, by extreme climatic conditions (in the polar areas of the northern hemisphere), and apparently, on the other hand, by historical reasons (in the regions of the southern hemisphere).

The largest territories are the areas with a middle intensity of natural preconditions and medium loimopotential by number of diseases. For instance, they cover practically the whole of North America, though the values of the sum intensity of natural preconditions and number of diseases are somewhat different in the temperate, subtropical and tropical belts. As for South America, medium intensity of natural preconditions exists mainly in the tropical belt.

Analysing the distribution of the intensity of natural preconditions in Eurasia, one can see that practically the entire area has a medium intensity, except for the peninsulas of Hindustan and Indochina, and mainly encompasses the temperate, subtropical and tropical belts. The maximum intensity of natural preconditions within this gradation is in the subtropical belt; in the tropical and temperate belts this indicator is lower. As for the number of basic natural-endemic diseases, the temperate belt belongs to the group with medium loimopotential, while a considerable part of subtropical and tropical belts falls into a category where the number of typical nosological units is maximum.

In Africa, the medium intensity of natural preconditions and the medium number of diseases can be found in the tropical belts of the northern and southern hemispheres. A similar situation is typical in the subtropical belt in the north of the continent.

It is worth noting that none of the listed regions has ubiquitous diseases. In spite of the fact that South America and Eurasia have the maximum number of nosoforms, there is no widespread disease. The only exclusion is Oceania. With a medium intensity of preconditions and medium loimopotential, it has two widespread diseases – malaria and necatoriasis.

Considerable are the areas with the highest risk of epidemical hazard, i.e. with a high intensity of natural preconditions. In the case of South America, the equatorial and subequatorial belts have the highest number of typical natural-endemic diseases (14). Africa is the region with the second-highest intensity of natural preconditions and a high loimopotential by the number of diseases, covering practically of the continent within the equatorial and subequatorial belts. As far as the subequatorial belt is concerned, regions to the north and south of the equator differ somewhat in the degree of epidemical hazard, in spite of the equal number of nosological units (14) and a high intensity of natural preconditions. To the north of the equator there is a higher intensity of natural preconditions for diseases (30), while many of the analysed nosological units are spread everywhere. Both the intensity of natural preconditions (25) and the number of widespread diseases are lower south of the equator. In Eurasia, areas with a high intensity of natural preconditions and considerable number of natural-endemic diseases are related to the subequatorial belt.

The analysis of the map makes it possible to find a number of regularities in the distribution of natural-endemic diseases all over the world. It is likely that on the global scale, geographical zonality of the environment creates the preconditions for typical natural-endemic diseases. The number of typical natural-endemic diseases closely connected to natural factors increases considerably from the cold to hot belts and reaches its maximum in the subequatorial belt. This rule is particularly evident in the Old World. The result achieved coincides with the well-known fact that the complexity and diversity of the structure of tropical ecosystems are much broader than those of polar ecosystems (Raikh and Maximova, 1988). In hot belts, the abundance of natural-endemic diseases linked with biota along with their widespread emergence makes the environmental extremes in these belts more pronounced. A common phenomenon of this area is poly-parasitism, because the high intensity of the transfer of tropical diseases by the population increases the probability of simultaneous infection by several kinds of pathogens.

In addition to the belt differentiation of environmental conditions, which are preconditions for typical natural-endemic diseases, there is a distinguishable medical geographical specificity in different continents. For example, Chagas disease is endemic to South America, sleeping sickness to Africa and eastern schistosomiasis to Asia. Tick-born encephalitis is present only in Eurasia, while the tick-born rickettsiosis of North Asia can only be found in Asia. Diseases caused by the eastern and western equin encephalomyelites viruses, Colorado fever and San Luis' virus are found only in America. The specificity of a continent is reflected not only in the conditions that determine the different ranges of typical natural-endemic diseases, but also in the considerable difference in their epidemiology.

A comparison of materials for Africa and Central and South America shows that there is also a difference in correlation between the investigated indicators –total number of diseases and number of ubiquitous diseases. In Africa, for instance, the increase in total number of diseases in the population is followed by the growth in the number of widespread nosoforms. There is no such tendency in South and Central America. The number of ubiquitous diseases is not high there, and virtually does not change with the increase in total number of diseases. Perhaps, this can be explained by historical reasons. It is more likely, however, that the socio-economic conditions in Central and South America strongly influenced the medical-geographical situation, thus leading to the decrease in number of ubiquitous natural-endemic human diseases.

3.2 Assessment of the intensity of natural preconditions in Africa

A more detailed analysis of the natural preconditions for distribution of natural-endemic diseases was conducted for Africa. The medical geographical assessment of natural conditions was carried out according to zonal types of landscapes.

On the basis of the methods described above, the medical geographical assessment and determination of environmental extremes were carried out for 20 typical nosological units on the list of natural-endemic diseases whose existence is controlled mainly by biota:

1) ancylostomiasis, 2) dipetalonematosis, 3) bancroftian filariasis, 4) transmissible viruses (except yellow fever), 5) dracunculiasis (guinea worm), 6) yellow fever, 7) loaiasis, 8) visceral leishmaniasis, 9) cutaneous leishmaniasis, 10) malaria, 11) onchocercosis, 12) tick-borne rickettsiosis (tick-borne spotted fever), 13) rat-borne rickettsiosis (rat-borne spotted fever), 14) tick-borne spirochetosis (tick-borne

relapsing fever), 15) Gambian trypanosomiasis (sleeping-sickness), 16) Rhodesian trypanosomiasis (sleeping-sickness), 17) frambesia, 18) plague, 19) intestinal schistosomiasis, 20) urinary schistosomiasis.

Next, the degree of potential epidemical hazard for selected regions, or, conditionally speaking, the intensity of natural preconditions in the areas, was evaluated for every disease on a three-level scale: high (3), medium (2) and low (1). Afterwards, the values showing the rate of intensity of the preconditions for particular diseases were summed up for all nosoforms in every zone or zonal type of landscapes. The resulting sum indexes are shown in Table 2.

Table 2. Natural-endemic diseases of Africa's natural zones.

Belt Zone *Type of altitudinal zonality*	Name of disease	Strength of natural preconditions	Sum index
Subequatorial Evergreen humid forests of eastern coasts	ancylostomiasis	3	39/18/9
	dipetalonematosis	2	
	bancroftian filariasis	3	
	transmissible viruses	3	
	dracunculiasis	2	
	yellow fever	3	
	loaiasis	1	
	visceral leishmaniasis	1	
	cutaneous leishmaniasis	1	
	malaria	3	
	onchocerciasis	3	
	spirochetosis	1	
	Gambian trypanosomiasis	3	
	Rhodesian trypanosomiasis	1	
	frambesia	2	
	plague	1	
	intestinal schistosomiasis	3	
	urinary schistosomiasis	3	
Deciduous evergreen forests and low-tree (typical) savannahs	ancylostomidoses	2	25/12/4
	dipetalonematosis	2	
	bancroftian filariasis	3	
	transmissible viruses	3	
	yellow fever	1	
	malaria	3	
	onchocerciasis	1	
	tick-borne spirochetosis	1	
	Rhodesian trypanosomiasis	2	
	frambesia	2	
	intestinal schistosomiasis	2	
	urinary schistosomiasis	3	
Forest-meadow, seasonally humid	ancylostomiasis	2	32/20/0
	dipetalonematosis	1	
	bancroftian filariasis	2	
	transmissible viruses	2	
	dracunculiasis	1	
	yellow fever	2	
	loaiasis	1	
	visceral leishmaniasis	2	
	cutaneous leishmaniasis	2	
	malaria	2	
	onchocerciasis	2	
	tick-borne rickettsiosis	1	
	rat-borne rickettsiosis	1	
	tick-borne spirochetosis	1	
	Gambian trypanosomiasis	2	
	Rhodesian trypanosomiasis	1	
	frambesia	1	
	plague	2	
	intestinal schistosomiasis	2	
	urinary schistosomiasis	2	

After the statistical calculation, the following gradations of the intensity of natural preconditions were found: less than 11 – very low, 11-17 – low, 18-24 – medium, 25-32 – high, and more than 32 – very high. Such a division gives more detailed information about the variation of the intensity of natural preconditions for diseases in Africa. The difference in the number of diseases is not as high, therefore, the three-level scale was chosen to assess diversity by the number of nosoforms: less than 9 – low, 9-14 – medium, and more than 14 – high.

The analysis made it possible to distinguish the medical-geographical types of areas, which are different in a range of

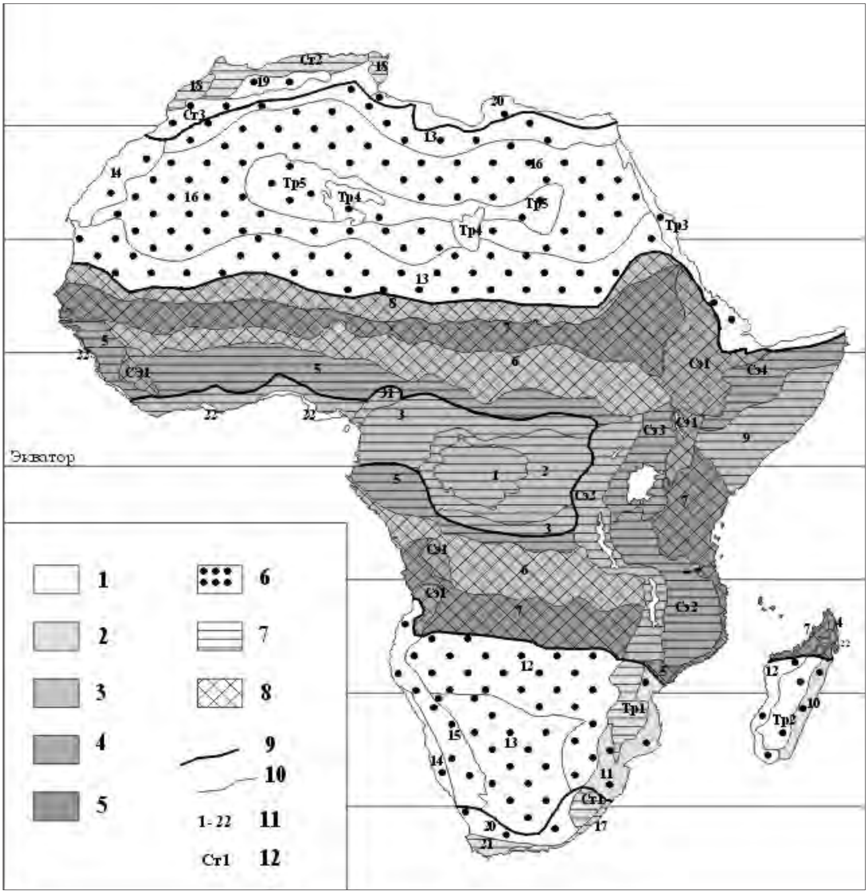

Fig. 2. Assessment of potential hazard of Africa's natural zones basing on a complex of natural endemic diseases.

Intensity of natural preconditions: 1 – very low, 2 – low, 3 – medium, 4 – high, 5 – very high; diversity by the number of nosoforms: 6 – low, 7- medium, 8 – high; 9 – the borders of geographical belts; 10 – borders of zones and subzones; 11- numbers of zones and subzones (*see key to Figure 2*); 12 – types of altitudinal zonality.

typical natural-endemic diseases and the rate of intensity of their biotical preconditions. The result of the cartographic-statistical analysis is presented in figure 2 – «Assessment of potential hazard of Africa's natural zones based on the complex of natural-endemic diseases».

As the map shows, the very high intensity of natural preconditions for diseases can be found in zones of moist evergreen forests, and savannahs, open woodlands and shrubs in the subequatorial belt. Here, the sum intensity of natural preconditions reaches 39 and 38 correspondingly, while the number of diseases is 18 and 17. The most favourable preconditions are for the transmission of ancylostomidoses, vuchereriosis, virus transmissible diseases, yellow fever, malaria, onchocercosis, Gambian trypanosomiasis and schistosomiases.

Key to Figure 2. Natural zones and subzones

1-3. EQUATORIAL BELT: 1 - regularly inundated evergreen rain forests (hylea), 2 – inundated evergreen rain forests (hylea), 3 - evergreen forests with admixture of deciduous species with a short relatively dry period; **types of altitudinal zonality**: _1 – *forest-steppe*,

4-9. SUBEQUATORIAL BELT: 4 **-** evergreen humid forests of eastern coasts, 5 – deciduous-evergreen forests and low-tree (typical) savannahs, 6 - semi-evergreen seasonally humid forests, 7 – savannahs, 8 - deserted savannahs, 9 - grass-shrub semideserts; **types of altitudinal zonality**: _1 – *forest-meadow seasonally humid,* C_2 - *forest-steppe,* C_3 – *savannah-forest-shrub,* C_4 – *woodland-thorn bush*

10-16. TROPICAL BELT: 10 - evergreen humid forests, 11 - deciduous-evergreen seasonally humid forests, 12 - savannahs, open woodlands and shrubs, 13 - shrub deserts and semideserts, 14 – semideserts and deserts of western coasts with high relative air humidity, 15 – grass-shrub and shrub deserts, 16 - deserts almost without vegetation; **types of altitudinal zonality**: _1 - *forest-meadow humid,* _2 - *forest-steppe seasonally humid,* _3 – *woodland-dwarf-shrub-semidesert,* _4 – *desert-steppe,* _5 – *desert-semidesert*

17-21. SUBTROPICAL BELT: 17 - coastal mixed evergreen humid forests, 18 - Mediterranean forests and shrubs, 19 – grass-shrub steppes, 20 - dwarf-shrub semideserts, 21 – coastal evergreen shrubs; **types of altitudinal zonality types of altitudinal zonality**: _1 - *forest-meadow,* _2 – *shrub-forest-steppe (Mediterranean),* _3 – *woodland-steppe continenta;*

INTRAZONAL LANDSCAPES*:* 22 - *mangroves*

Territories with the high intensity of natural preconditions for diseases occupy the zone of semievergreen forests and park savannahs as well as the mountain landscapes in the subequatorial belt: forest – seasonally moist meadow, forest – steppe, savannahs – forest – shrubs and open woodlands – thorn shrubs. Typical for the zone of semievergreen forests and park savannahs are 12 diseases of which four – vuchereriosis, virus transmissible, malaria and urinary schistosomiasis – present serious epidemic hazards. Notable for the mountain landscapes is the maximum diversity in number of nosoforms (20). However, natural preconditions are optimal for the parasitic systems in none of them.

The medium intensity of natural preconditions for diseases can be found in the zones of moist forests of the equatorial belt, as well as in the landscapes of semievergreen forests, deserted savannahs and grass-shrub semideserts of the subequatorial belt. The zonal types of landscapes in the subequatorial belt have the maximum diversity in number of nosoforms. In the forests of the subequatorial belt, the number of typical natural-endemic diseases is somewhat lower, although the most favourable conditions for some of them (malaria and frambesia) are there.

The areas with s low intensity of preconditions occupy zones of seasonally moist semievergreen and evergreen forests of the tropical belt, zones of evergreen mixed forests, Mediterranean sclerophyllous evergreen open woodlands and shrubs of the subtropical belt, as well as the mountain landscapes of these zones. In comparison with the tropical belt, the subtropical one is notable for the large number of diseases. These belts have, correspondingly, a medium and low degree of diversity by the number of nosoforms.

The very low intensity of the natural preconditions and low loimopotential in relation to the number of diseases can be found in the savannahs, open woodland and shrubs, deserts and semideserts of the tropical and subtropical belts. The least intensity of preconditions and minimum number of diseases is in southern semideserts of the subtropical belt, where, evidently, mainly the natural seats of plague and tick-borne rickettsiosis are potentially dangerous for humans.

Summarising the medical geographical assessment of the world's landscapes, it is necessary to note that some regions are truly extreme in relation to a complex of natural-endemic diseases, and this fact must be taken into account during the integrated planning of land development and land use. It is worth emphasizing that with the future development of agriculture and other branches of the economy, the medical-geographical situation may worsen. Also, when considering the environmental extremity of an area for human health, it is worth paying attention to mechanisms of social adaptation, i.e. the possibility of environmental improvement towards a more favourable situation by means of prophylactic and sanitary measures. Therefore, a topical issue is to compile assessment maps at the regional and local levels that show the potential hazard of an area in relation to the complex of natural-endemic diseases and the possible changes in the medical geographical situation caused by human impact.

References

IGNATIEV E. I. (1964): «Principles and methods of medical geographical analysis of natural components of the environment». *Medical Geography,* Irkutsk (In Russian), pp. 20-42.

LOFFLER H. and MALKHAZOVA S. M. (1988): «Man and environment». In *Wetland and Shallow Continental Bodies*. Vol. 1. The Netherlands, The Hague, SPB Academic Publishing, pp. 347-362.

MALKHAZOVA S. M. (2001): *Medical geographical analysis of territories: mapping, assessment and forecast*. Moscow, Scientific World (In Russian).

MALKHAZOVA S. M. and KARIMOVA T. YU. (1990): «Assessment of the medical geographical consequences of farming». *Geographia Medica*, 20, pp. 67-86.

MALKHAZOVA S. M. and NERONOV V. M. (1983): *Regional geography of* *leishmaniasis*. Part I. Moscow, VINITI (In Russian).

MALKHAZOVA S. M. and NERONOV V. M. (1988): «The consequences of anthropogenic changes of native landscapes in terms of medical geography». *Agricultural Production and the Environment*. Vol. 3. Moscow, UNEP, pp. 125-155.

NERONOV V. M. and MALKHAZOVA S. M. (1985): *Regional geography of leishmaniasis*. Part II. Moscow, VINITI (In Russian).

NERONOV V. and M., MALKHAZOVA S. M. and TIKUNOV V. S. (1991): *Regional geography of plague*. Moscow, VINITI (In Russian).

Present-day landscapes of the World (map, 1: 15 000 000). Moscow, 1993.

RAIKH E. L. and MAXIMOVA L. V. (1988): «Medical geographical territorial differentiation». *Izv. AN SSSR, Ser. Geography*, 6, pp. 34-43 (In Russian).

RESOURCES AND ENVIRONMENT (1998). *World Atlas Institute of Geography*. Russian Academy of Sciences (IG RAS), Russia, Moscow and Ed. Hölzel, Vienna. First edition, V. 1-2.

VERSHINSKY B. V. (1964). «Mapping of natural foci diseases in relation to the study of their geographical distribution in Russia». In *Medical Geography,* Irkutsk (In Russian), pp. 62-103.